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Comparison of HIRDLS L1 and L2 Data for T, O_3 and H_2O with ECMWF Analyses and Derived Radiances

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Validation Activities at RAL

- Outline of Work
- Correlative Data
- Relevant Instrument Details
- Radiance Comparisons (L1)
- Product Comparisons (L2)
- Summary and Conclusion

Outline

- The work carried out at RAL covers two aspects:

  – Examination of HIRDLS corrected radiances, L1/HIRRAD, for channels designated for T, H_2O and O_3
    - Comparison with simulated radiances using ECMWF met analysis fields

  – Examination of HIRDLS L2 T and O_3
    - Comparison to ECMWF geophysical data and sonde data

Correlative Data

ECMWF Analyses

Temperature, H_2O and O_3 data

- Taken on a regular 1.125˚ x 1.125˚ grid in lat/lon, on model levels (60 levels up to 0.1 hPa)
- Data available at 4 times throughout the day (00.00, 06.00, 12.00 and 18.00 UTC)
- For comparisons, data interpolated spatially and in time to the locations of HIRDLS measurements

Correlative Data

Sonde Data

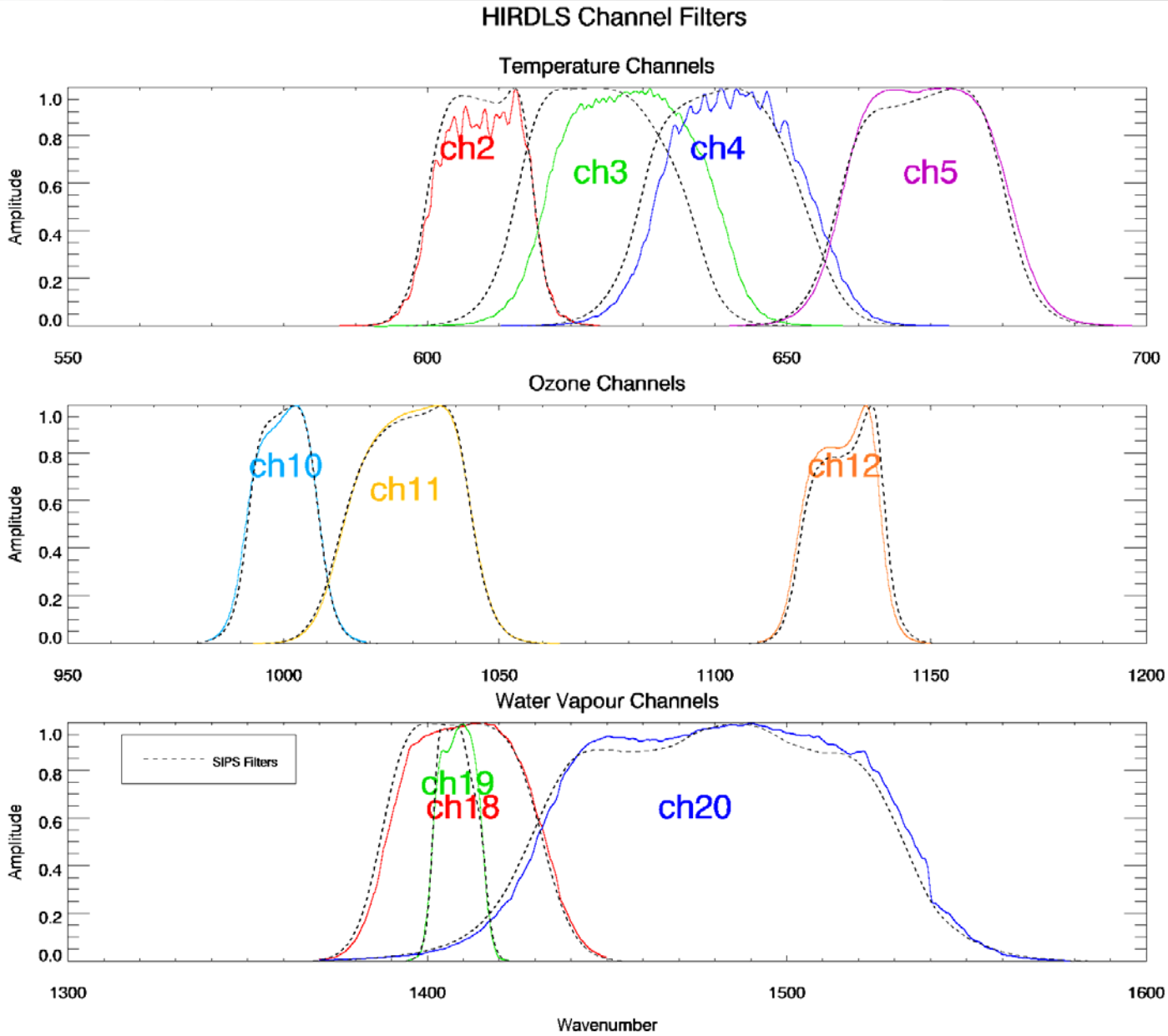
Temperature profile data

- UKMO high resolution radiosondes obtained from the BADC
- 9 stations worldwide (many around UK)
- Matching criteria : 300 km & 3 hrs

Instrument

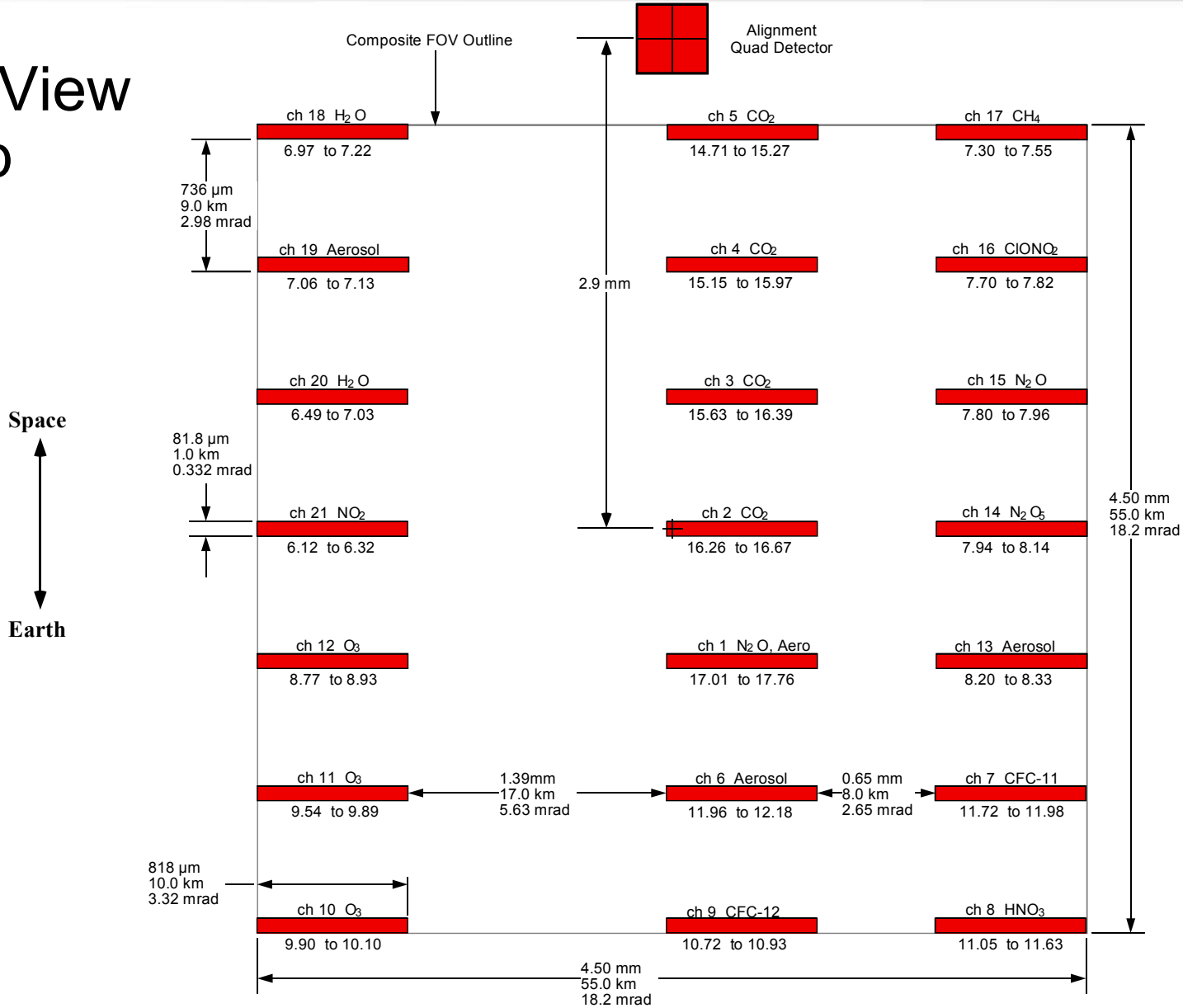
	Channel	Species	50% Response (cm^{-1})		Sounding Range (km)	Radiometric Noise ($10^{-4}\,Wm^{-2}sr^{-1}$)
			Lower	Upper		
	1	N_2O, A	563.50 ± 2.0	587.25 ± 1.0	8–70	12.0
Temperature	2	CO_2-L	600.50 ± 2.0	614.75 ± 1.0	8–40	6.3
	3	CO_2-M	610.00 ± 3.0	639.50 ± 2.0	8–60	5.9
	4	CO_2-M	626.00 ± 3.0	660.00 ± 3.0	15–60	6.0
	5	CO_2-H	655.00 ± 3.0	680.00 ± 2.0	30–105	4.3
	6	A	821.50 ± 2.3	835.00 ± 2.4	8–55	1.9
	7	CFC11	835.00 ± 2.4	852.00 ± 2.4	8–50	2.0
	8	HNO_3	861.50 ± 2.5	903.50 ± 2.5	8–70	4.2
	9	CFC12	916.00 ± 2.6	931.50 ± 2.6	8–50	2.0
Ozone	10	O_3-M	991.00 ± 2.8	1009.00 ± 2.8	8–55	1.5
	11	O_3-H	1011.00 ± 2.9	1046.50 ± 2.9	30–85	2.4
	12	O_3-L	1120.00 ± 3.2	1138.50 ± 3.2	8–55	0.96
	13	A	1202.00 ± 3.4	1259.75 ± 3.4	8–55	1.1
	14	N_2O_5	1229.50 ± 2.0	1259.75 ± 1.0	8–60	1.1
	15	N_2O	1256.25 ± 1.0	1281.75 ± 1.0	8–70	1.1
	16	$ClONO_2$	1278.25 ± 1.0	1298.75 ± 1.0	8–70	1.1
	17	CH_4	1325.50 ± 3.8	1367.50 ± 3.8	8–80	1.2
Water Vapour	18	H_2O-L	1387.00 ± 4.0	1435.00 ± 4.0	8–40	1.2
	19	A	1402.25 ± 1.0	1415.75 ± 1.0	8–55	1.3
	20	H_2O-H	1422.00 ± 4.1	1542.00 ± 4.3	15–85	1.6
	21	NO_2	1585.50 ± 4.5	1630.50 ± 4.6	8–70	1.1

Instrument


HIRDLS Channel Filters
Temperature Channels
Amplitude
1.0
0.8
0.6
0.4
0.2
0.0
ch2
ch3
ch4
ch5
550
600
650
700
Ozone Channels
Amplitude
ch10
ch11
ch12
950
1000
1050
1100
1150
1200
Water Vapour Channels
Amplitude
SIPS Filters
ch19
ch18
ch20
1300
1400
1500
1600
Wavenumber

Instrument

Field of View Map

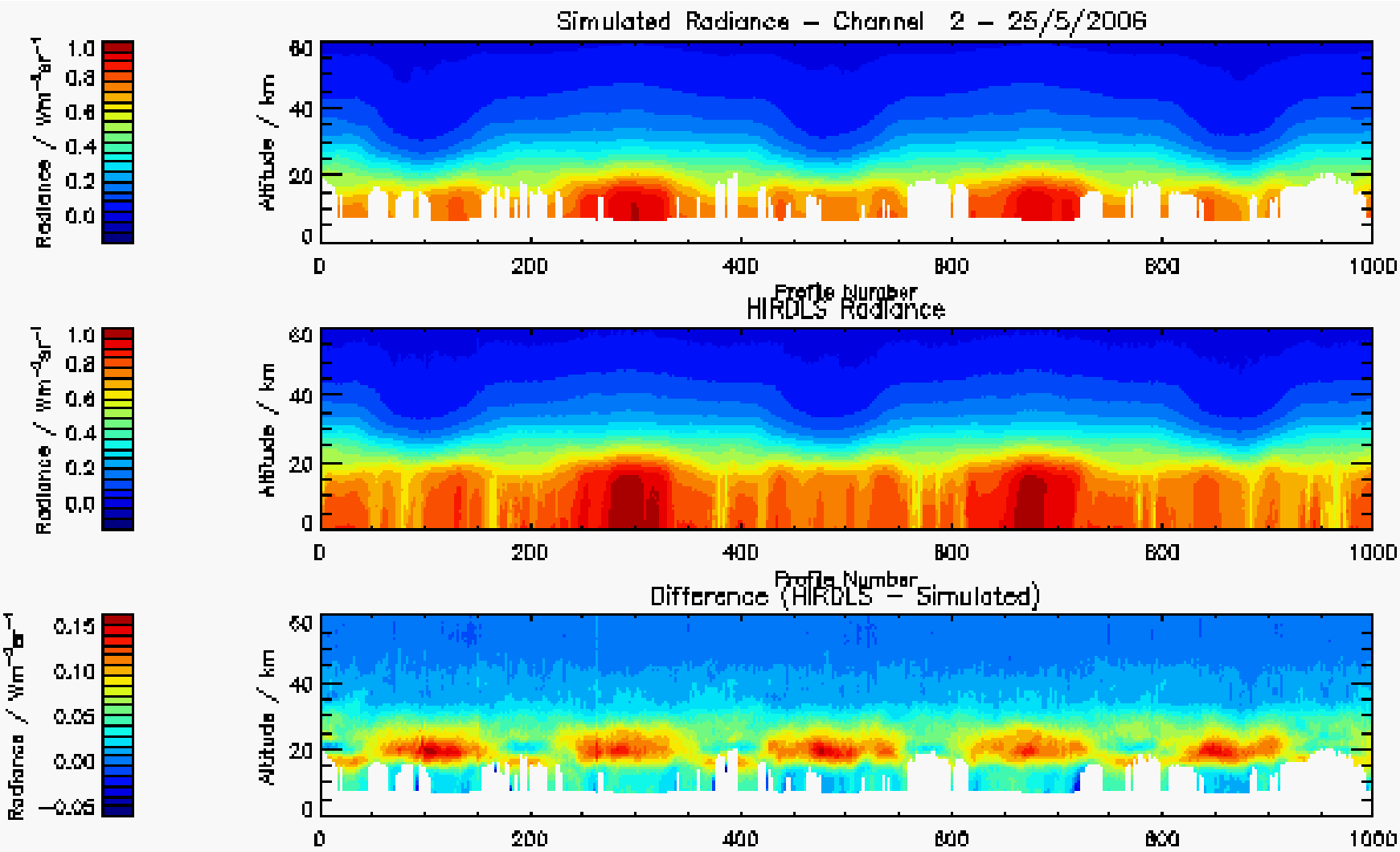


L1 Comparisons

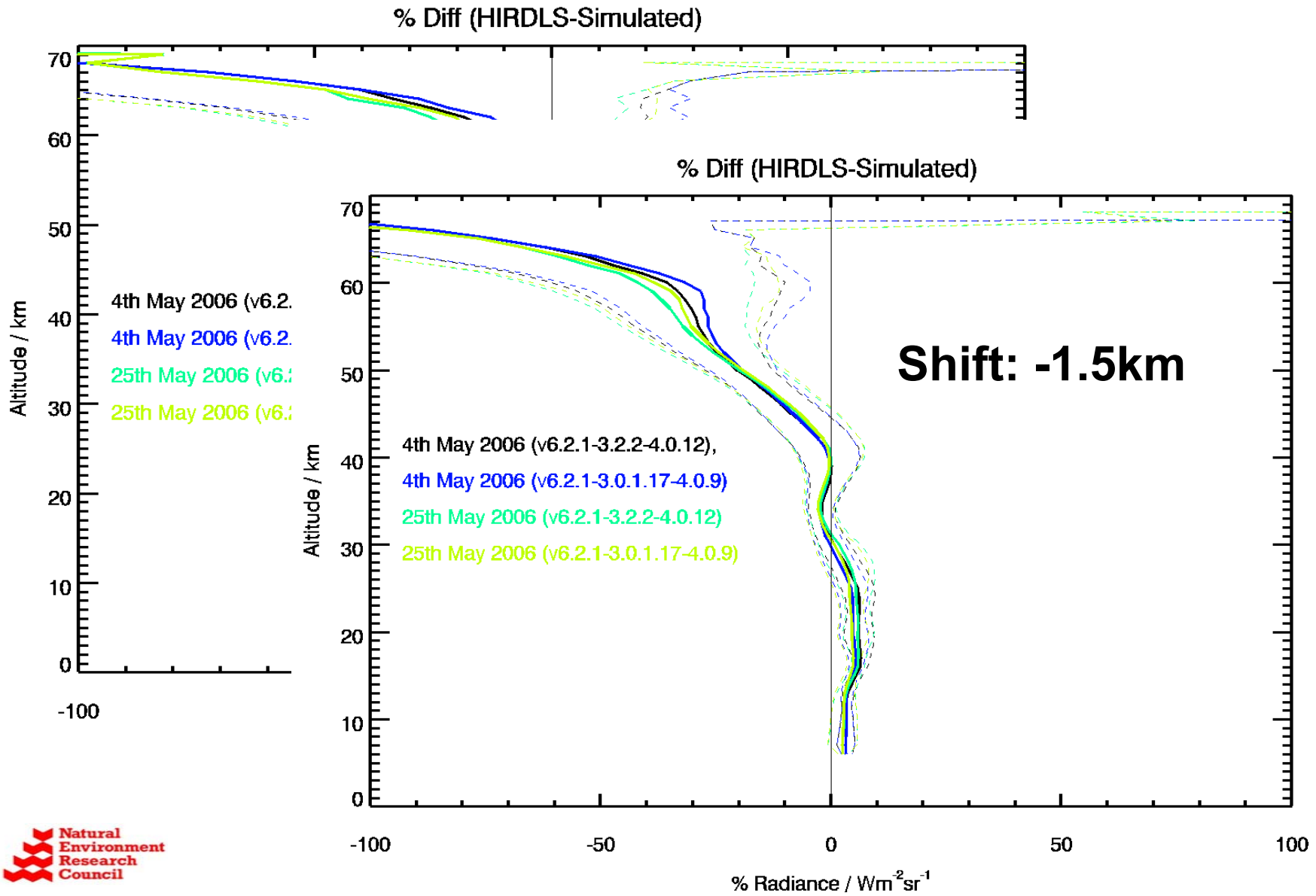
- Calculations
  - Radiances generated using the HIRDLS FM for May 2006 period
  - Channels
    - 2 – 5 (temperature)
    - 10 – 12 (ozone)
    - 18 & 20 (water vapour)
  - Calculations based on the HIRRAD data files
  - Temperature, H_2O and O_3 taken from ECMWF, other contaminants from HIRDLS climatology files

Note: Cloud not included in the simulations and aerosol only as simple cilmatology so there will be tropospheric deviations cf HIRDLS measurements for some channels

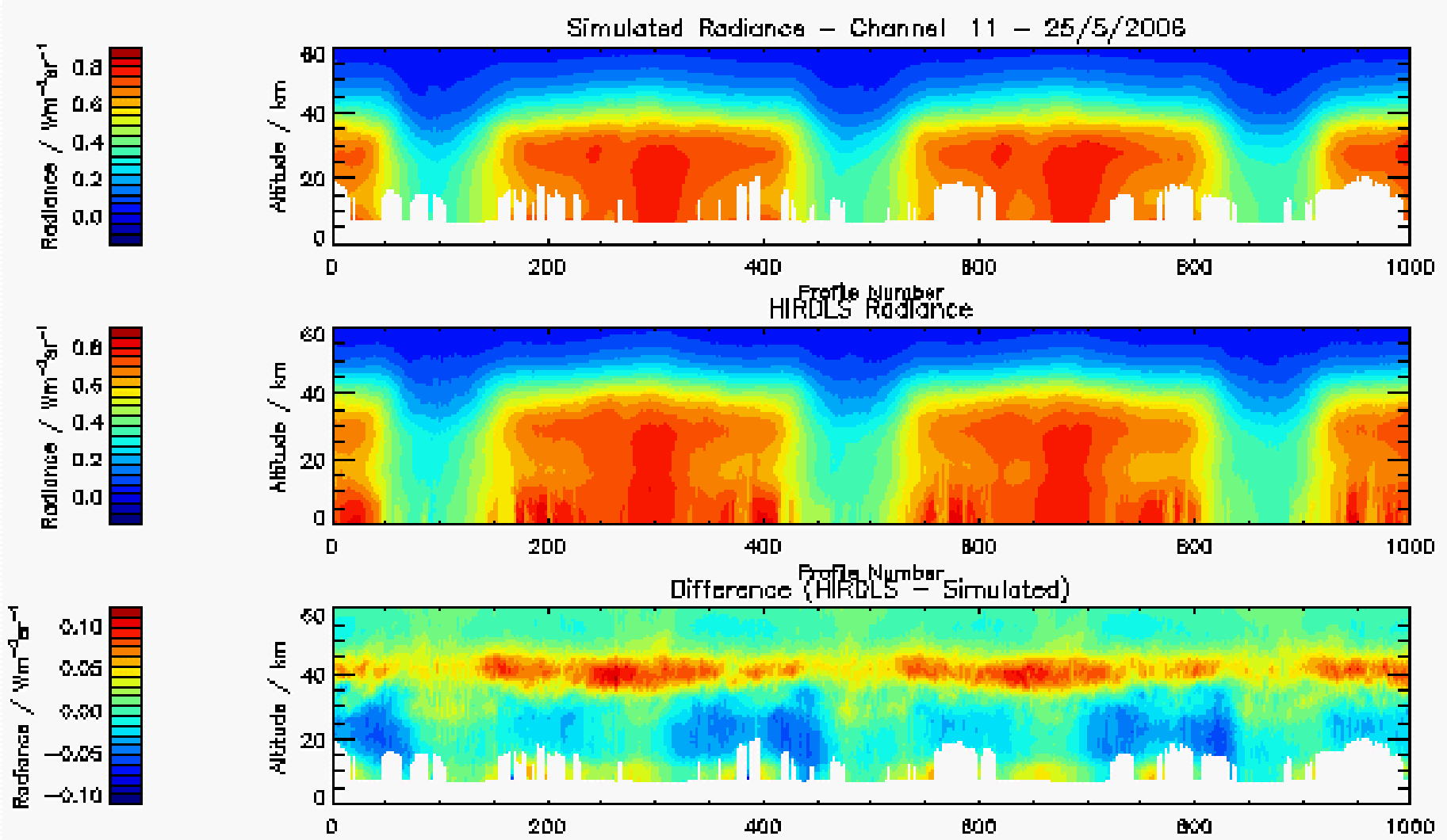
Temperature Channel 2



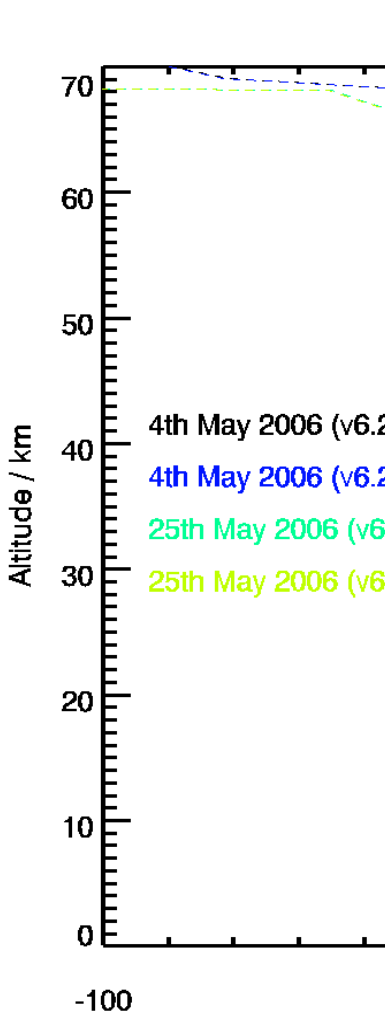
Temperature Channel 2

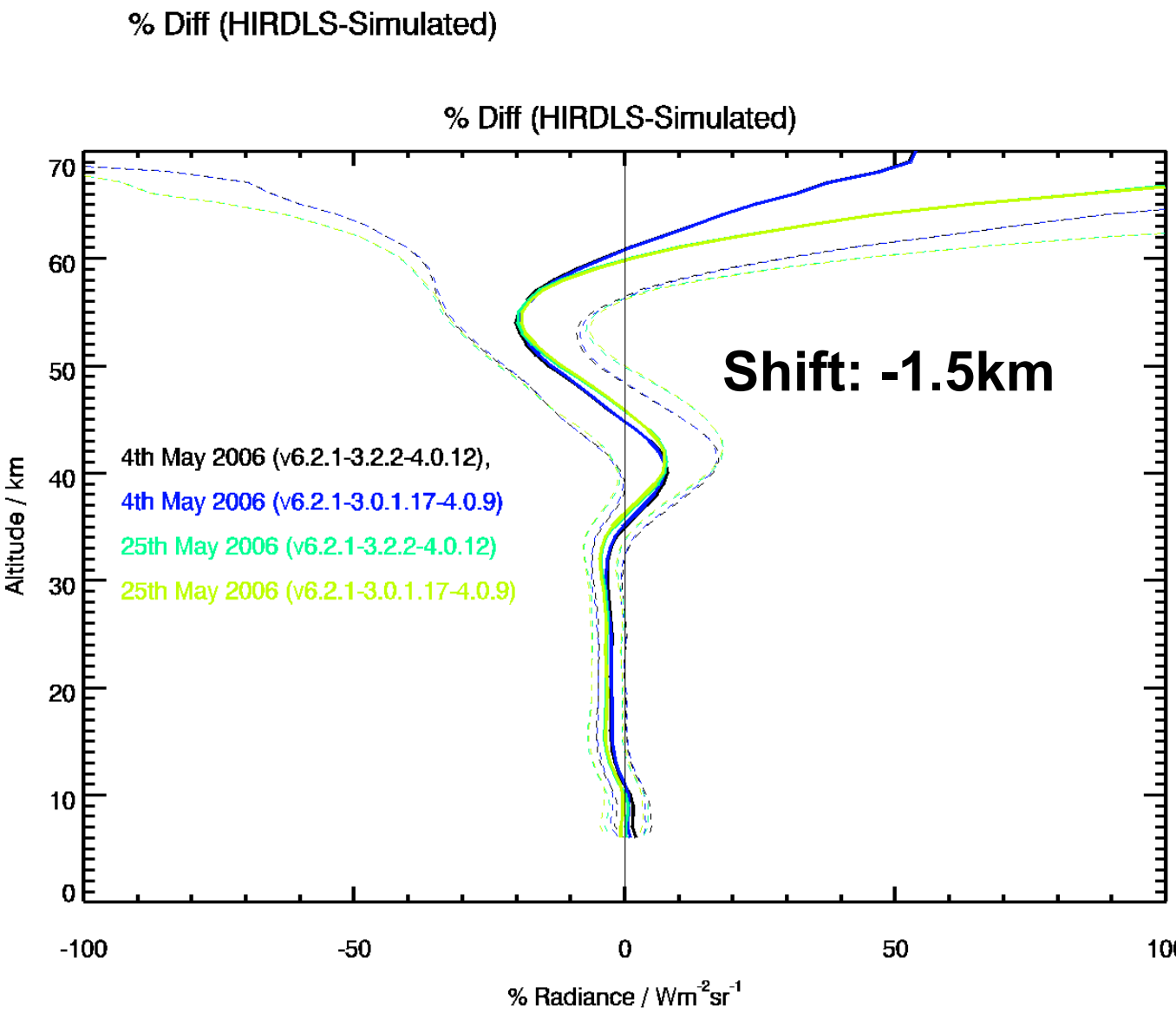


Ozone
Channel 11

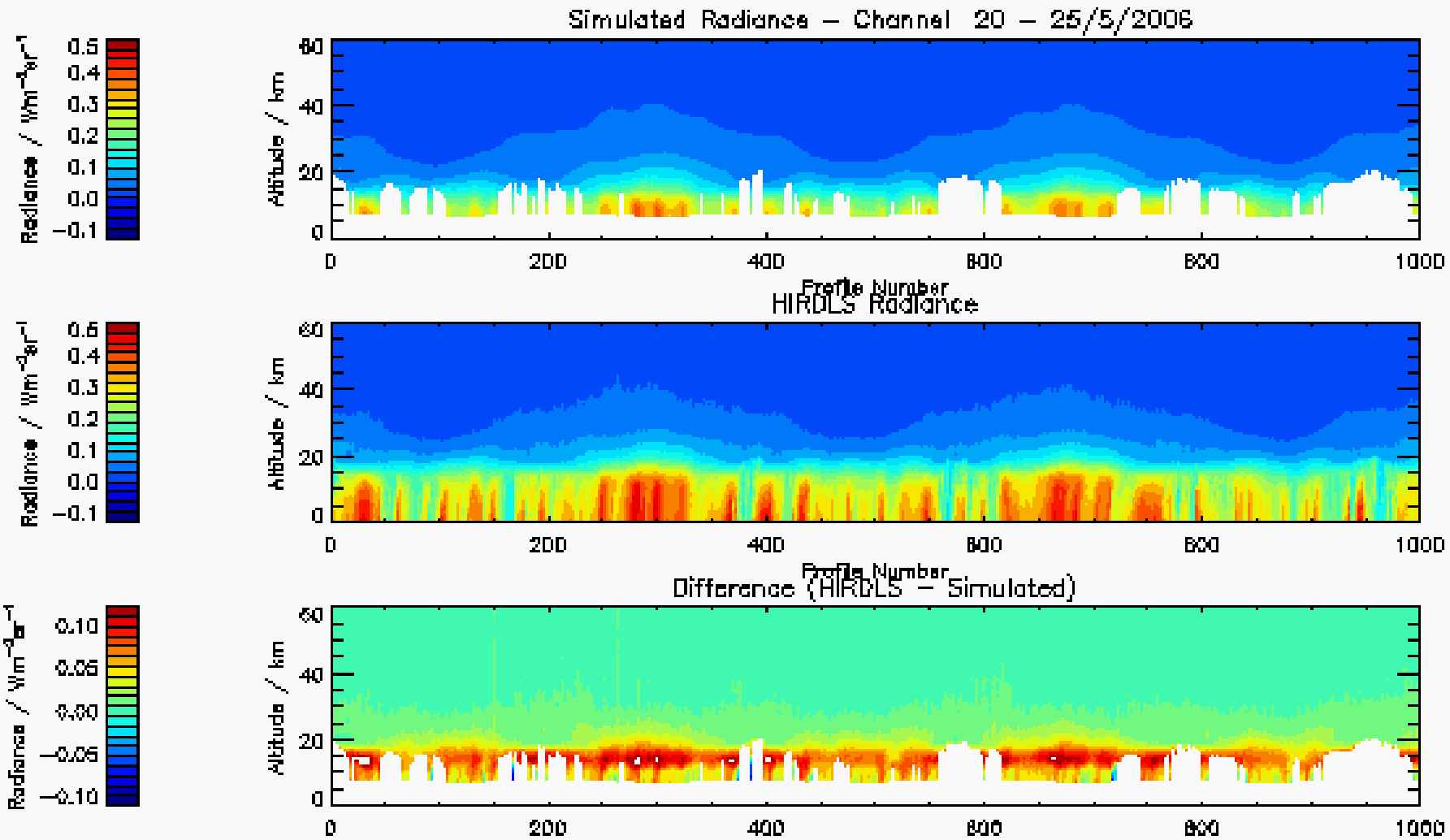


Ozone Channel 11

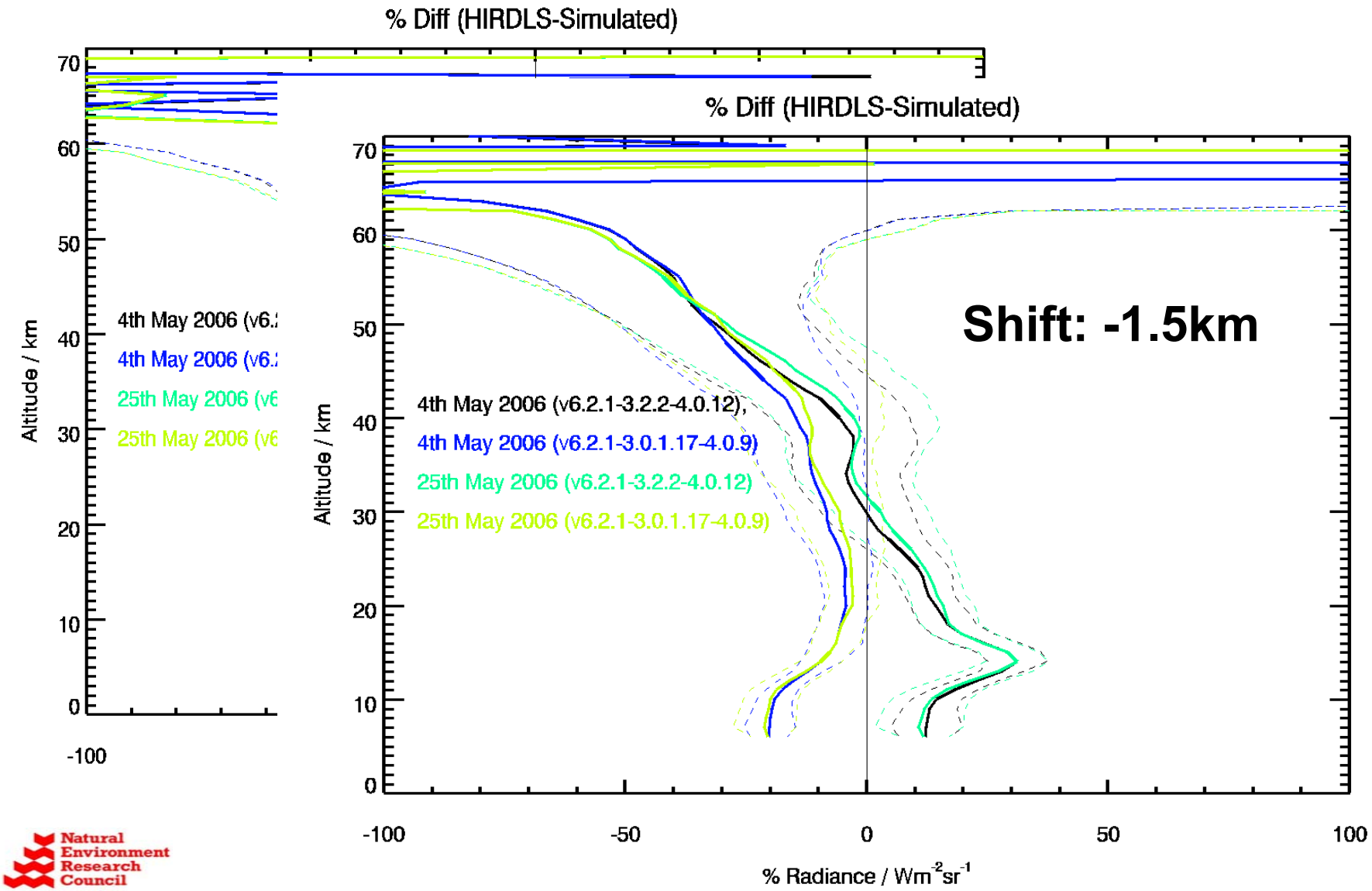




Water Vapour Channel 20



Water Vapour Channel 20



L2 Comparisons

ECMWF Data

- L2 data compared directly with ECMWF analysis data interpolated spatially and temporally to HIRDLS profile positions

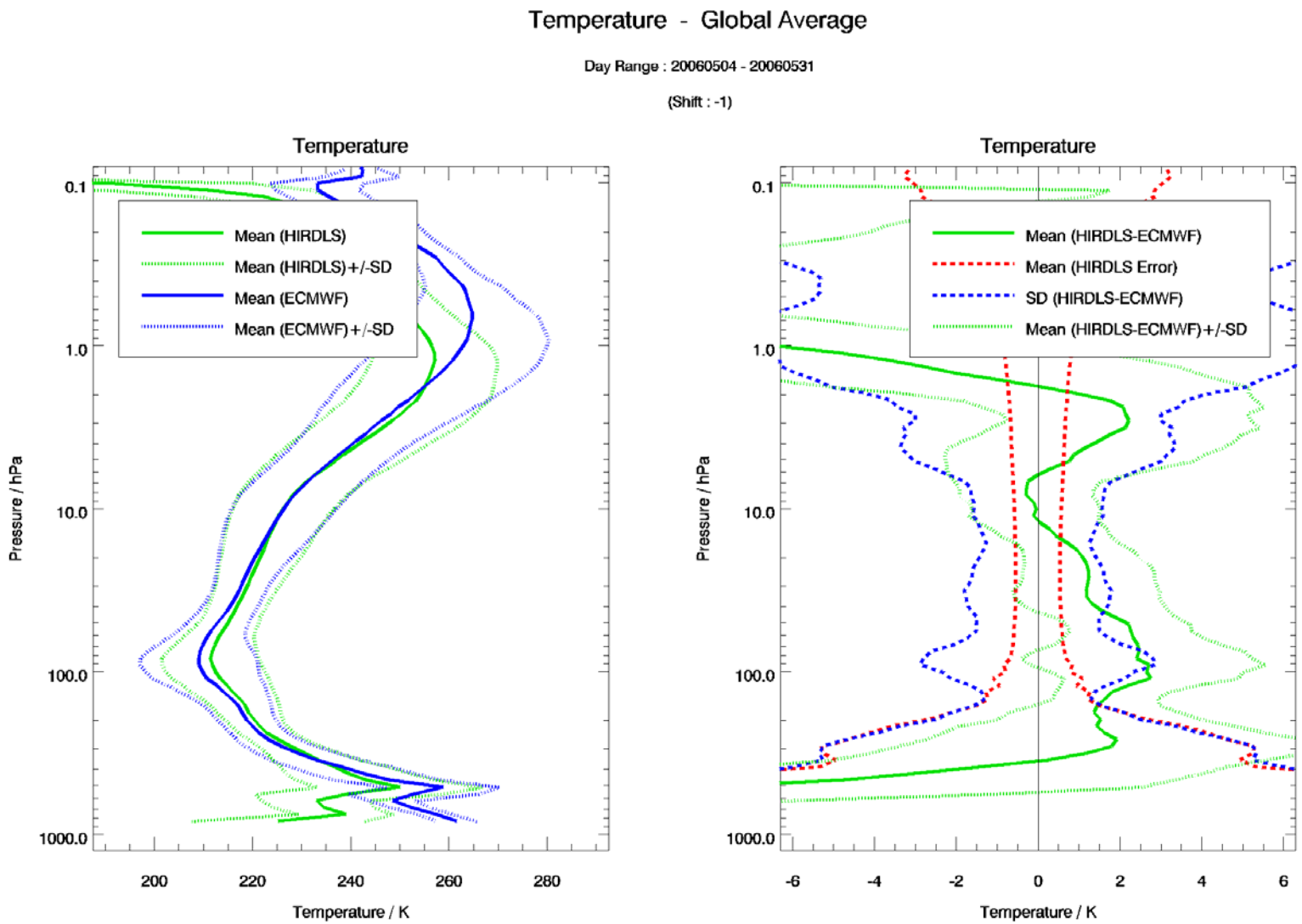
HIRDLS Data

- Data versions V2.00 & V2.02

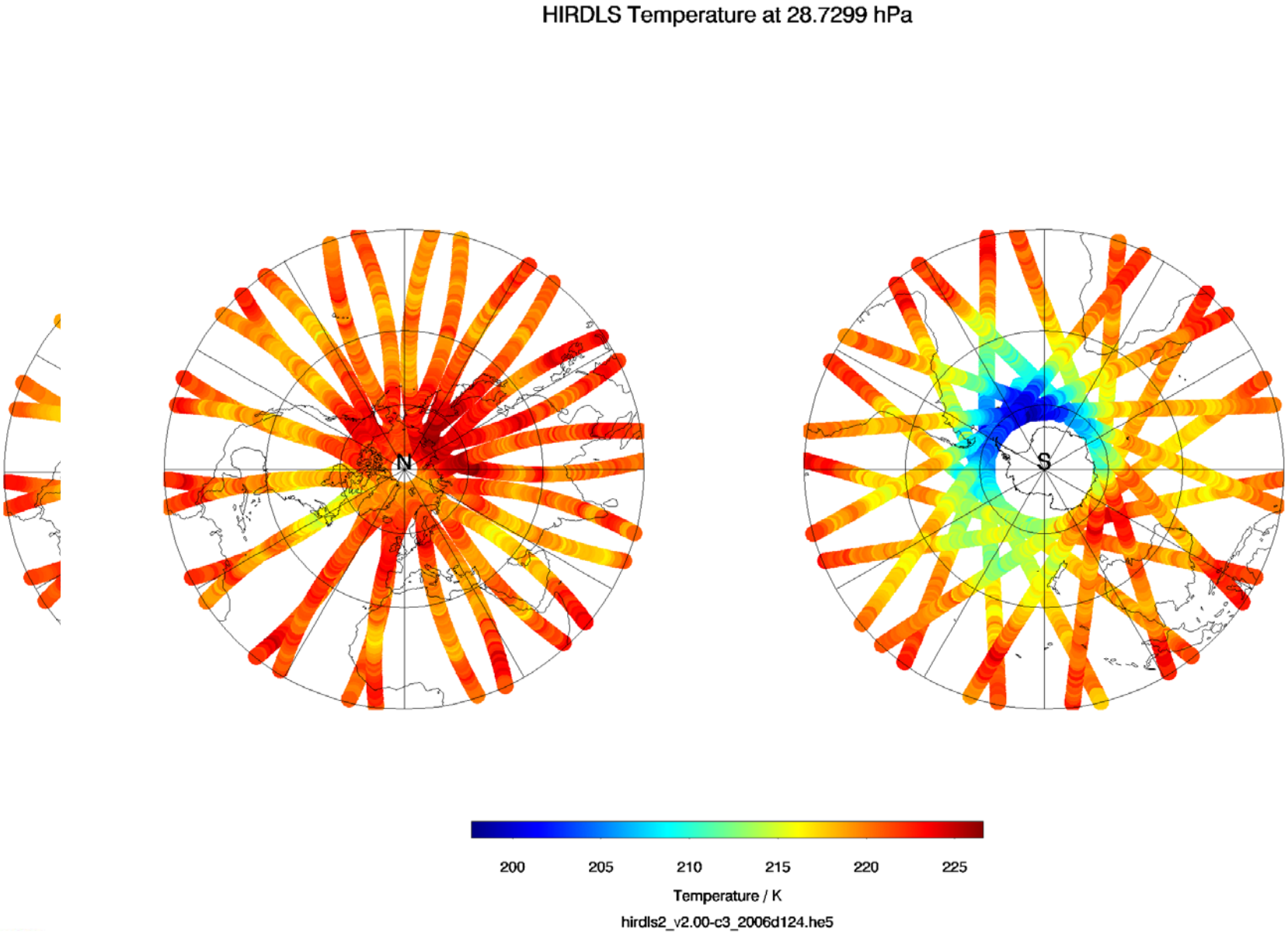
Sonde Data

- UKMO high resolution radiosondes

Temperature

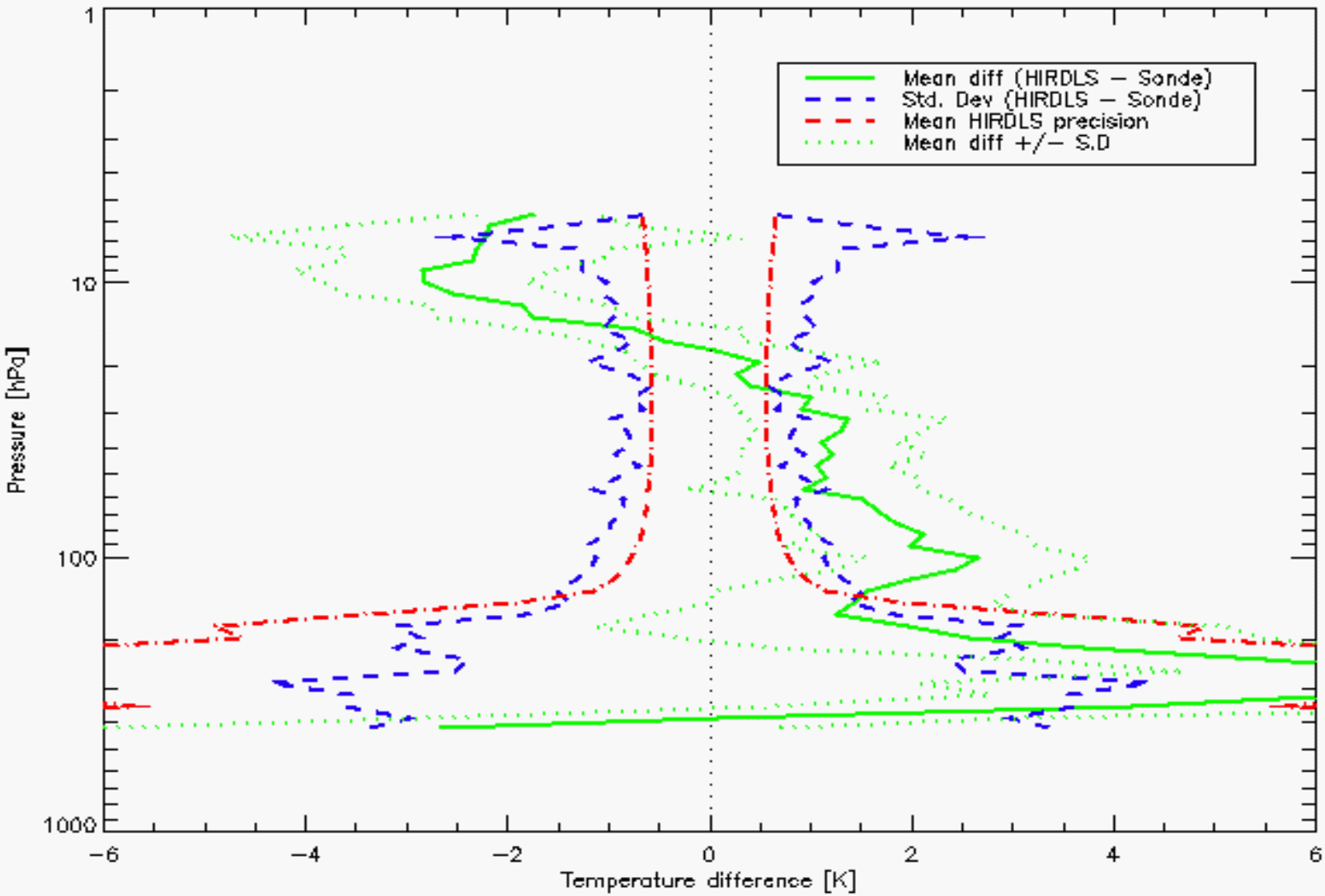


Temperature



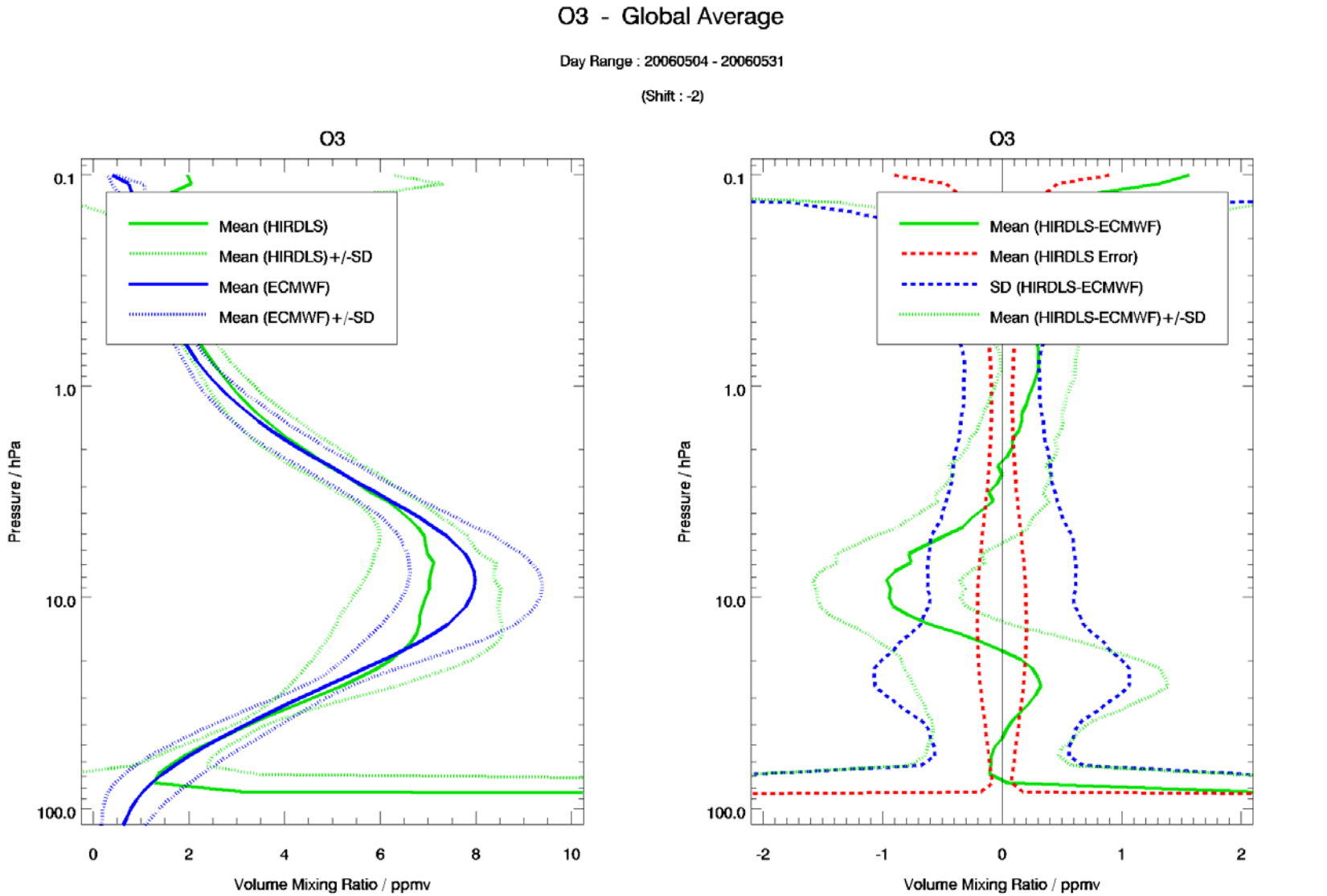
Temperature

V2.02



Cambourne Sondes

Ozone



HIRDLS Version : v2.02

Conclusions

Summary & Conclusions

- Radiance Comparisons
  - Radiance profiles have been simulated using the HIRDLS FM and ECMWF data
  - HIRDLS radiances show atmospheric structure predicted from the ECMWF data
- Product Comparisons
  - HIRDLS L2 T and O_3 results have been compared to data from sondes and ECMWF
  - Temperature data shows good agreement with correlative profiles; ~1-2K bias in the stratosphere
  - O_3 profiles agree at the 1ppmv level; ~1ppmv bias at peak